

Appendix I

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PROPOSED METHODOLOGY FOR DEFINING AND ASSESSING THE 1-IN-10 YEAR LEVEL OF CERTAINTY FOR THE LOWER EAST COAST PLANNING AREA

Problem Statement. Determine if the level of certainty for water supply is consistent with the planning goal of 1-in-10 year drought protection on a regional and subregional basis within the Lower East Coast (LEC) Planning Area.

BACKGROUND

Section 373.0361, Florida Statutes (HB 715), sets a planning goal for regional water supply plans of identifying existing and future reasonable and beneficial uses and meeting these needs during a 1-in-10 year drought event. The law also requires identification of water supply options necessary to meet the 1-in-10 year level of certainty planning goal. Staff have recommended that the water supply development components of the plan meet this level of certainty through the District's Consumptive Use Permitting (CUP) process and criteria.

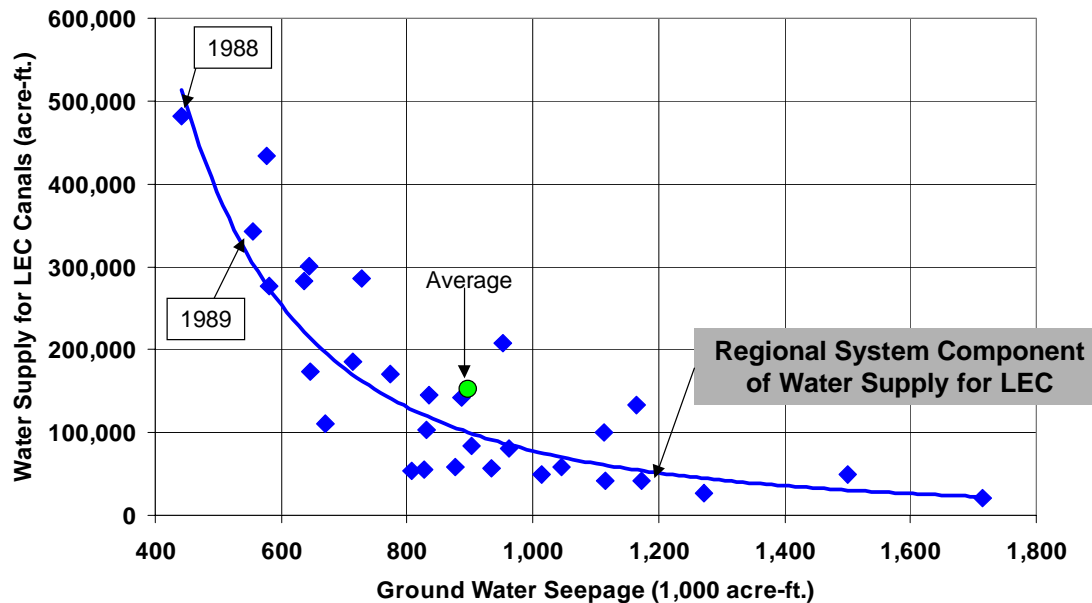
In order to determine if the planning goal will be met, it is necessary to develop a definition of the 1-in-10 year level of certainty on a regional and subregional basis. A subcommittee of the Lower East Coast (LEC) Regional Water Supply Advisory Committee was formed and given the task of developing, along with District staff, a workable definition of the 1-in-10 year level of certainty. With the 1-in-10 year definition established, the regional and subregional models would be used to determine if a plan alternative meets the planning goal.

Regional Level of Certainty

A proposed definition for the 1-in-10 year level of certainty for the regional system was developed based on the concept that water levels in Lake Okeechobee would not fall into supply-side management conditions more than three times in 31 years. The regional model, known as the South Florida Water Management Model (SFWMM), was been used extensively in the Central and Southern Florida Project Comprehensive Review Study (Restudy) and other LEC planning efforts. For this plan, the *Lower East Coast Regional Water Supply Plan* (LEC Plan), it would be used to assess if the regional level of certainty criteria were met. The demands on the lake simulated in the regional model would incorporate the pumpage from the 2020 with Restudy alternative and would be evaluated under the hydrologic conditions that occurred between 1965 and 1995.

Subregional Level of Certainty

The subregional area consists of the LEC service areas east of the north/south levees and includes ground water and surface water inflows from the regional system. On the subregional level, the 1-in-10 year level of certainty criteria initially discussed by the subcommittee was to meet the demands resulting from a localized rainfall drought conditions with a return frequency of approximately once in ten years over a duration of 12 months under average regional inflow conditions. The ability to meet the 2020 1-in-10 year demands would be assessed using the subregional ground water models. Regional water supply deliveries to the LEC service areas were defined as the sum of the surface water deliveries through the primary canal system plus the ground water seepage beneath the western levees. Average daily regional inflows for both surface and ground water would be calculated from the regional model based on the 31-year simulation period (**Figure I-1**). These average daily data would be used for the boundary conditions of the subregional model analysis.



Notes:

The data corresponds to the 2020 with Restudy alternative presented to the advisory committee in July 1999.
Each point corresponds to the 12-month period starting in November every year.
The trend lines highlight the inverse relationship between the two variables.

Figure I-1. Regional Water Supply for LEC Canals versus Ground Water Seepage to the east in the 2020 with Restudy Alternative (November through October period).

However, during the evaluation of the proposal, it was determined that the use of the calculated average daily data would take significant time to compile. Staff proposed an alternative approach using the actual daily levels calculated by the regional model during the selected 1-in-10 year drought for the subregional boundary conditions. This proposed modification was discussed and agreed to by the subcommittee.

Should the subregional model results yield satisfactory results with the regional inflows as described above, it will be necessary to check the availability of surface water back to Lake Okeechobee. Staff proposes the following check back to the lake. Once the subregional models are run successfully (subregional performance measures are acceptably met) with 1-in-10 year rainfall and corresponding demands, the cumulative volumes of surface water delivered from the primary canals will be compared back to the regional model simulations for the lake. If the volumes of water needed by the canals during the 1-in-10 year drought on the subregional level are capable of being delivered by the lake, then the subregional demands are assumed to be met.

MODELING TOOLS TO BE USED IN THE ANALYSIS

The high resolution, subregional ground water models were developed, in part, to address level of certainty issues discussed here. Other applications of these models included the Water Preserve Area Feasibility Study (WPA) analyses for the Restudy, the assessment of potential impacts of permit criteria on the cumulative impacts of all withdrawals, and to support individual water supply development planning of permit holders. Originally, staff's intent was to develop these applications concurrently through the water supply planning process. However, the complexity associated with the model configurations resulted in delays. The subregional models are now completed using daily time steps over an eight-year period of record. The models contain many layers, necessary for certain analyses, such as the evaluation of seepage control of the WPAs. As a result, the models are computationally rigorous and not well suited for regulatory or localized permit planning.

Once the high resolution subregional planning models were complete, the models were to be revised and documented for regulatory applications. The regulatory model conversions will involve generalizing and simplifying the time steps, layering, and scope of study. The resulting models would be able to run on conventional computers and become a part of the water use permitting process. The conversion process is under way, along with the documentation. However, the amount of time needed by the public to review the regulatory models and for District staff to evaluate the proposed regulatory criteria changes and to analyze the variety of potential water supply development options proposed by the regulated public, exceeds the amount of time available. The the LEC Plan must be completed by May 2000. In order to complete the LEC Plan on schedule, the regulatory evaluation will be conducted after the plan is completed. In addition, in order to meet the planning goal on both a subregional and regional basis by May, the high resolution ground water models, along with the regional model, should be used to evaluate the 1-in-10 year level of certainty.

PROPOSED TECHNICAL EVALUATION OF THE 1-IN-10 YEAR LEVEL OF CERTAINTY

Staff proposes to modify and apply the high resolution planning models in the ways described below to determine if the LEC service areas are 1-in-10 year drought compliant. This exercise will provide a planning level answer to the level of certainty question on a subregional basis, but not necessarily on a project scale where permit issues occur (see disclaimers below). The 1-in-10 year level of certainty for Lake Okeechobee, the Everglades Agricultural Area (EAA), the Caloosahatchee River Service Area, and the C-44 Basin will be determined using the regional model results.

Rainfall Analysis

In order to save time and more accurately represent the system, staff proposed using actual historic rainfall data in the subregional planning models instead of synthetic daily data. To do this, staff completed the statistical return frequency analysis on the rainfall data from the LEC rainfall stations to identify the 1-in-10 year rainfall accumulations over a 12-month period. The 1-in-10 year drought rainfall amounts were calculated using the statistical methodology described in Appendix B of the *Upper East Coast Water Supply Plan* (SFWMD, 1998).

Originally, staff proposed to use the period of record data from 12 rainfall stations that were used in the water use permitting process. This approach was revised based on recommendations of the subcommittee to include all rainfall stations used in the regional SFWMM. This was accomplished by analyzing the cell-by-cell rainfall data used in the SFWMM simulations. The period of record for all rainfall stations was limited to 31 years (same length as the simulation). The locations of all the rainfall stations are shown on **Figure I-2**.

Based on this evaluation, the closest historic fit regionwide for the calculated 1-in-10 year drought conditions occurred from June 1989 to May 1990. The temporal and spatial distribution of the rainfall is the same as that originally configured in the regional SFWMM.

Figure I-3 shows the geographic locations where the 1-in-10 year drought conditions were generally met or exceeded. It was noted, however, that the June 1989 through May 1990 rainfall accumulations were greater than 1-in-10 year return frequency in portions of LEC Service Area 3 (Miami-Dade County). In these areas, rainfall was closer to normal conditions. As a result, staff looked at other 12-month periods to identify a closer 1-in-10 year fit. A better match for Miami-Dade County was found for the period of May 1989 to April 1990. The level of certainty subcommittee reached agreement to recommend the use of this 12-month window to represent the 1-in-10 year level of certainty for Miami-Dade County and the June 1989 to May 1990 window for the remaining service areas.

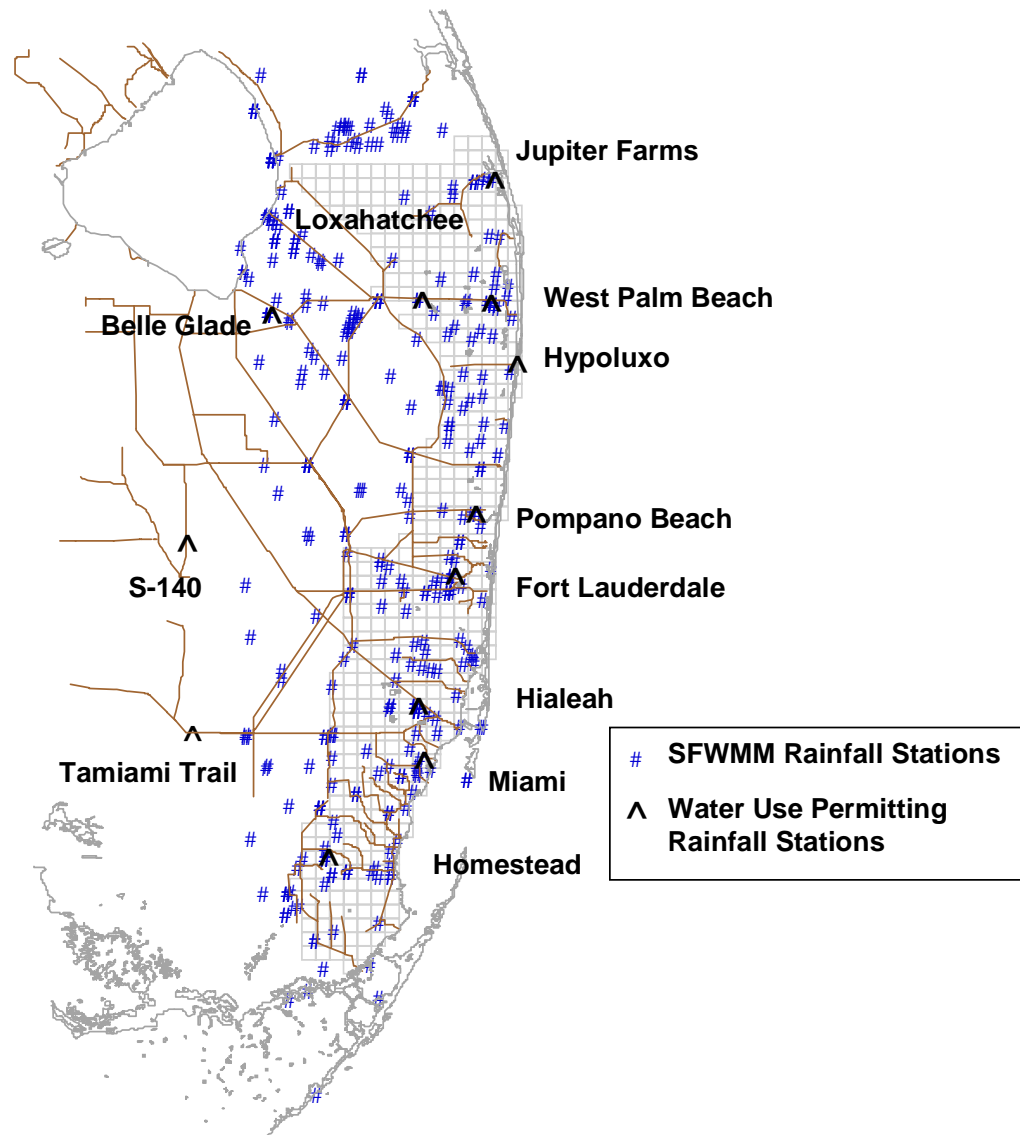


Figure I-2. Rainfall Stations Used for SFWMM Modeling and Water Use Permitting.

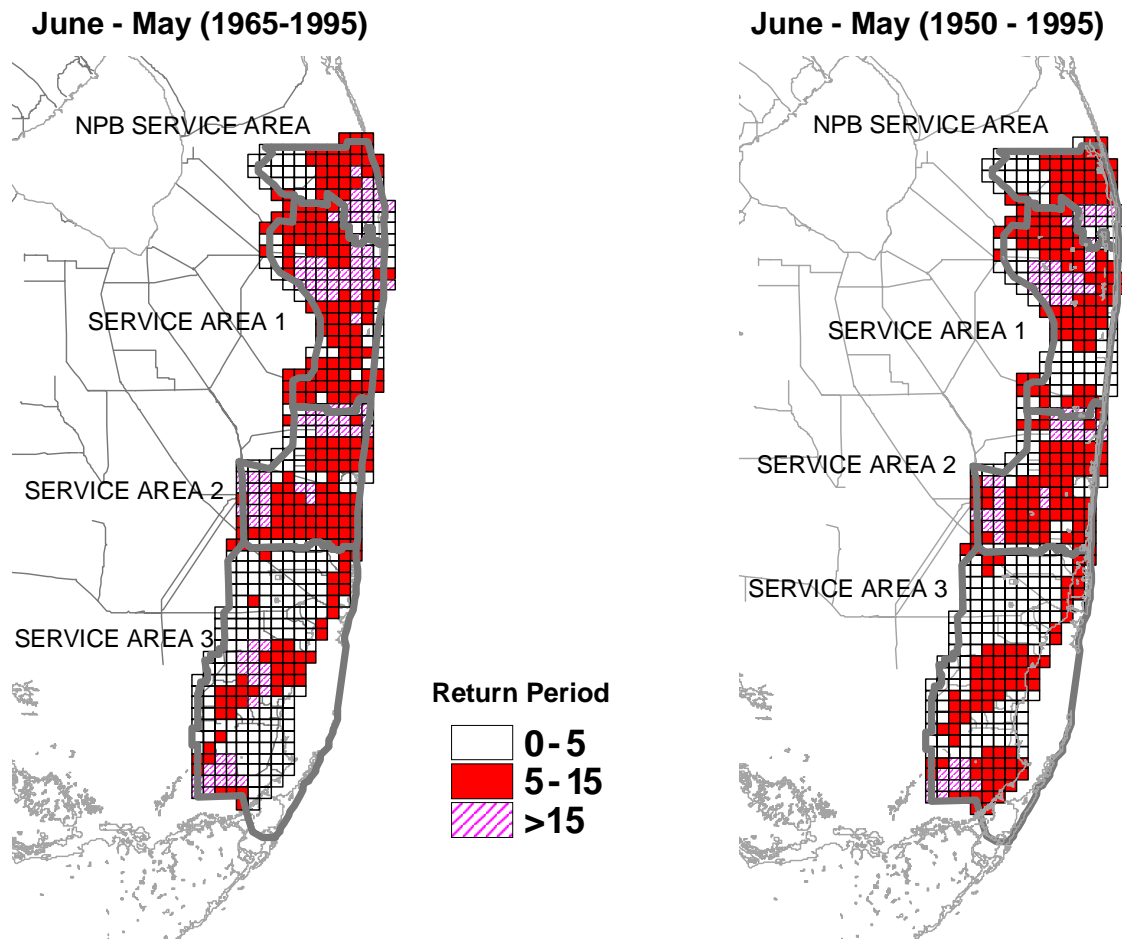


Figure I-3. Geographic Locations Where the 1-in-10 Year Drought Conditions Were Generally Met or Exceeded.

Model Analysis

Each ground water model will simulate conditions for three years (1988-1990). The simulation will begin with a warm-up period followed by the 12-month 1-in-10 year drought event (as described above), and concludes with a recovery period. The warm-up period allows the model to stabilize before the start of the 1-in-10 year drought window. The model simulation continues six to seven months beyond the drought event in order to examine how the system recovers. It should be emphasized that only the two-year period (1989-1990) will be used to evaluate system performance.

Public water supply demands will be represented by the 2020 projections prepared by staff with input from the utilities (see **Appendix B**). Irrigation demands would be based on the modified Blanney-Criddle supplemental crop irrigation method developed by the University of Florida's Institute of Food and Agricultural Sciences (IFAS) and used in the water use permitting process. The supplemental irrigation demands for this simulation were based on a 1-in-10 year drought, not the 1-in-5 year drought currently used in district

water use rules. Regional inflows from canals and ground water base flow beneath the levees would be derived from the regional SFWMM for the concurrent time periods as discussed above.

Based on this, the following procedure will be used to see if the LEC preferred alternative for 2020 is 1-in-10 year level of certainty compliant:

1. The LEC subregional models will be run with the 2020 demands and alternatives in place for the three-year simulation period from January 1988 through December 1990.
2. The LEC performance measures plus the 1-in-10 year performance measures discussed below will be simulated against the result of the three-year simulation. If acceptable subregional performance is achieved, the regional checks will be made.
3. The first regional check compares the hydropatterns generated by the SFWMM in the Water Conservation Areas (WCAs) and Everglades National Park to those of the Restudy to see if they are consistent during the same three-year simulation period.
4. The second regional check is to determine how many significant supply-side management events occur for Lake Okeechobee in the 31-year SFWMM simulation. The lake should have no more than three such significant events during the simulation period.

If all these criteria are met, the plan will be considered to meet the level of certainty planning goal.

1-IN-10 YEAR LEVEL OF CERTAINTY PERFORMANCE MEASURES

Specific performance measures that will be used to assess the impacts of demands during the 1-in-10 year drought simulations along the LEC are as follows:

- Coastal flow will be analyzed along the saline water interface. The position of the allowable inland extent of the saline interface along the coast will be defined and the performance analysis will be directed towards determining if saline water has a net annual inflow across this line as a result of pumping during a drought.
- Drawdowns of greater than one foot resulting from pumping will be evaluated for isolated wetlands located east of the levees. The regional wetland systems associated with the Everglades system will be evaluated using the performance goals established in the Restudy.
- The sum of the ground water seepage and the surface water deliveries generated during the design drought will be compared to the allowable total regional inflows into each service area during the drought as defined in the 2020 with Restudy simulation. Local demands for

regional water in excess of the flows calculated from the 2020 with Restudy simulation are not acceptable.

- Water shortage triggers will be used to determine if cutbacks would be imposed. Imposing water use restrictions under the 1-in-10 year level of certainty is not considered a success.
- Lake Okeechobee, based on a regional check, must have no more than three significant supply-side management events during the 31-year simulation.

DISCLAIMERS

The purpose of this analysis is to determine if the LEC Plan meets the 1-in-10 year level of certainty planning goal. While the approach used here is very similar to that used in the evaluation of a consumptive use permit application, this process is not meant to replace the future rulemaking process discussed below. Therefore, the water supply development options included in this planning process will need to be refined in order for the project to be permitted. The approach described in this appendix is based on meeting the definition of 1-in-10 year level of certainty that was provided through the subcommittee. Should the definitions change, the approach described above may have to be modified.

REGULATORY ANALYSIS

As stated above, staff are in the process of modifying the high resolution models configured for planning applications to meet regulatory applications. These modifications will include the following:

- The 1-in-10 year rainfall will be synthetically calculated on a monthly basis using the methodology described in the *Upper East Coast Water Supply Plan* (SFWMD, 1998) distributed across Thiessen polygons from rainfall stations that will be defined in District water use rules.
- All irrigation demands will be evaluated based on the modified Blanney-Criddle formula for a 1-in-10 year drought averaged on a monthly basis. Return flows to ground water, where applicable, will be accounted for as proposed by rule. Public water supply systems demands will be distributed over a monthly time step based on historic use patterns.
- Transient model runs will use monthly time steps starting with average rainfall/demand months (March, April, and May) followed by the 12-month 1-in-10 year drought simulation and nine months of average conditions.
- District staff will work with the public through meetings of a subcommittee of the LEC Regional Water Supply Advisory Committee

to evaluate and refine the regulatory aspects of the LEC recommended plan and the impacts of the proposed rule changes.

REFERENCES

SFWMD. 1998. *Upper East Coast Water Supply Plan*. Planning Department, South Florida Water Management District, West Palm Beach, FL.

